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AN ANALYSIS OF THE EFFECTS OF INCREASES IN AVIATION BONUSES ON THE RETENTION OF NAVAL AVIATORS USING AN ANNUALIZED COST OF LEAVING (ACOL) APPROACH

by

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I. INTRODUCTION

A. BACKGROUND AND PURPOSE

The training of Naval aviators, both pilots and Naval Flight Officers (NFO) is one of the most expensive investments in human capital undertaken by the Department of the Navy. To achieve an acceptable level of return on this investment, sufficient retention of Naval aviators must be achieved. To assist in maintaining a high enough level of retention, the Navy provides financial incentives, in the form of aviation bonus pays, to aviators to induce them to stay in the Navy. The aviation bonus pays are Aviation Career Incentive Pay (ACIP) and Aviation Career Pay (ACP). ACIP is a monthly payment given to all Naval aviators. ACIP reaches its maximum value of $650 a month at the point when Naval aviators have completed the initial service obligation incurred from flight training and must make a decision to stay in or leave the Navy. The other aviation bonus pay, ACP, is offered to aviators in selected communities when shortages of experienced mid-career pilots and NFOs are projected. ACP payments are currently up to $12,000 per year for as long as 9 years. The purpose of this thesis is to examine the effects of proposed increases in these aviation bonus pays on the retention of Naval aviators.

B. SCOPE AND GOALS

The approach used to examine hypothetical increases in aviation bonus pays on retention is to use an Annualized Cost of Leaving (ACOL) model to compare the differences between an individual's expected future earnings if he chooses to stay in the Navy and continue a military career versus leaving the Navy to pursue a civilian career. The model allows changes in the cost-of-leaving variable in response to increases in aviation bonus payments to simulate the effect of the bonuses on retention behavior. Additionally, the ACOL model incorporates an individual's

preference, or "taste," for military and civilian life when making the retention/separation decision. The goals of this thesis are:

1. To develop an Annualized Cost of Leaving (ACOL) model for Naval aviators;

2. To develop a logit regression model, using the ACOL framework, to predict retention of Naval aviators;

3. To apply the logit retention model to simulate the effects of increases in aviation bonus pays on the retention of Naval aviators.

The benefit of this thesis to the Navy is in determining potential aviator replacement cost savings possible through increases in aviation bonus pays. According to LT Mike Martin, of PERS 211 (Aviation Community Managers) currently, the Navy spends $12,000,000 a year on ACP and $74,600,000 a year on ACIP. By increasing the amounts available to these programs, retention of Navy aviators is expected to improve.

Chapter II provides an introduction to the ACOL model and a review of relevant literature. The data and methodology used in this thesis are presented in Chapter III. Chapter IV presents the analytical results of changes to aviation bonus pays on the retention of Naval aviators. Finally, Chapter V offers conclusions and recommendations concerning aviation bonus pays and future areas of research.

II. LITERATURE REVIEW

A. THE ANNUALIZED COST OF LEAVING MODEL

The Annualized Cost of Leaving model, or ACOL, is an econometric model developed by Warner and Goldberg (1984) to predict whether a service member will stay or leave the military after finishing his obligated service. The assumption behind ACOL is that individuals make career choices so as to maximize their utility, including the monetary returns. Decision makers balance the cost and benefits to them of each choice, weighing both monetary and nonpecuniary aspects of the decision. Thus, when a service member is trying to decide on whether to stay in the military, ACOL assumes the individual weighs the perceived cost and benefits of the alternatives of staying in the military or leaving immediately for civilian employment. Cymrot (1987) states that although the ACOL model concentrates on monetary aspects, the taste or preference for military service is equally important when deciding whether or not to stay in the military. Some individuals will remain in the service even though they could make more money as a civilian. To some people, the travel, type of work, or patriotism makes military service preferable to any civilian employment. On the other hand, some people prefer being a civilian, even if their military pay is higher than what they can earn in the civilian labor market. In the ACOL framework, there will be individuals with a negative cost of leaving who nonetheless, will stay in the military; conversely, others with a positive cost of leaving will separate nonetheless.

After an individual completes his initial obligated term of service, he must choose between remaining in the military or leaving to pursue a civilian career. The decision to stay or leave the military is made by comparing the utility of leaving immediately with the utility of staying in the military for n more years, where n =

1,2,...s and s represents the maximum allowable future years of service. As stated earlier, the utility of this decision is affected both by monetary considerations, in the form of the individual's expected future earnings, and by non-monetary factors, such as net preferences for a civilian lifestyle.

If an individual chooses to stay in the Navy for n more years, then his expected future earnings are comprised of the present value of two pay streams. The first is the present value of future military pay. The second is the present value of post-service military retirement pay and any post-retirement civilian pay. If an officer chooses to leave the Navy, his future earnings are determined solely by the present value of his civilian pay beginning at the time of separation. The non-monetary factor affecting this decision to stay or leave is defined as an individual's preference, or "taste", for a military lifestyle or a civilian lifestyle. By assigning a monetary equivalent to an individual's preference for a military or civilian lifestyle, a net preference for a civilian lifestyle can be determined.

If an officer's cost of leaving, calculated using the present values of the future earnings streams, is greater than his net preference for civilian lifestyle, the model hypothesizes that he will choose to stay in the military. To express this, Warner and Goldberg used the following definitions:

M_j = the individuals's expected military pay in each future year of service, $j = 1,...s$

R_{jn} = the yearly retired pay the individual will receive after n more years of service, with $j = n+1,...T$, where T equals life expectancy.

W_{j0} = the future civilian earnings stream the individual expects to receive if he leaves the military immediately, $j = 1,...T$

W_{jn} = the future civilian earnings stream the individual expects to receive if he leaves the military after n more years of service, $j = n+1,...T$

p = the individuals yearly discount rate

$(1/(1+p))^j$ = the present value of one dollar received j years in the future, at the time of the stay or leave decision, where $j = 1,...T$

Let Y_m and Y_c denote the annual monetary equivalents, or preferences, of the non-monetary aspects of military and civilian life, respectively. Warner and Goldberg assumed these factors to be fixed over time for any given individual, but that they vary across individuals.

The utility of remaining in the military is greater than the utility of leaving the military immediately only if:

$$\sum_{j=1}^{n} \frac{Mj+Ym}{(1+p)^j} + \sum_{j=n+1}^{T} \frac{Rjn+Wjn+Yc}{(1+p)^j} > \sum_{j=1}^{T} \frac{Wjo+Yc}{(1+p)^j},$$

where the first summation on the left-hand side is the present value of military pay plus the preference for military life, over the period of n more years of military service. The second summation on the left-hand side is the present value of post-service retirement pay plus post-service civilian pay until death. The right-hand side of the equation represents the summation of the present value of civilian pay plus the preference for civilian life if the individual leaves the service immediately.

The condition for remaining in the military can also be expressed as:

$$Cn = \sum_{j=1}^{n} \frac{Mj}{(1=p)^j} + \sum_{j=n+1}^{T} \frac{Rjn+Wjn}{(1+p)^j} - \sum_{j=1}^{T} \frac{Wjo}{(1+p)^j} > (Yc-Ym) \sum_{J=1}^{n} \frac{1}{(1+p)^j}$$

or in the abbreviated form:

$$Cn > \delta \sum_{j=1}^{n} \frac{1}{(1+p)^j}$$

where C_n is the "cost of leaving" or the difference between the present value of the two pay streams and δ is the net preference for civilian life over military life, (*Yc - Ym*). According to Hogan and Black (1991) , δ can be thought of as the amount the individual would be willing to pay each year to be a civilian/not be in the military if annual military and civilian compensation were the same.

By dividing both sides of the equation by

$$\sum_{j=1}^{n} \frac{1}{(1+p)}$$

the condition for remaining in the military becomes:

$$An = \frac{Cn}{\sum_{j=1}^{n} \frac{1}{(1+p)^j}} > \delta$$

where A_n is the annualized cost of leaving, or ACOL, over the period of *n* more years of service and δ is the net preference for civilian life.

Using this model, an individual prefers a strategy of remaining in the military for *n* more years to a strategy of leaving immediately only if the annualized cost of leaving exceeds the net preference for civilian life, or $A_n > \delta$. An individual will choose a strategy of leaving immediately to any strategy that involves remaining in the military only if $A_n < \delta$ for all $n = 1,\ldots s$. According to Hogan (1995), this is

equivalent to finding the maximum difference between military pay and the best alternative for the horizon, *s*, or *max* A*n* < δ. It follows that if this maximum difference is not sufficient to induce an individual to stay in the Navy, then no lessor A*n* would be either. Therefore, the relevant ACOL value for the retention decision is the maximum over the set ($A_1 \ldots A_s$), and the relevant time horizon for the retention decision is the one over which the ACOL value is maximized.

Because the monetary value of an individual's preference for civilian life (Yc-Ym) cannot be observed, it is assumed that these differences are a function of a vector of individual characteristics, X_i, and a random error component, e_i. So, the decision rule for individual *I* to remain in the military for at least one more year is: $ACOL_i + bX_i > e$, where b is a vector of parameters, and X is a vector of individual characteristics.

To estimate retention using the ACOL model, Cymrot(1989) states:

> In the ACOL model the underlying distribution of preferences for military service has generally been assumed to fit a logistic distribution. This assumption of a logistic distribution is made because it provides a reasonable fit of the data and is relatively easy to use. The logistic distribution is symmetrical and has a declining density in its tails. This shape implies that changes in the cost of leaving have a larger impact on the retention rate when the retention rate is in the middle range, that is, between 0.2 and 0.8, than when it is at either extreme. This implication is thought to have intuitive appeal because it suggests that the number of individuals with extreme preferences, either strongly for or strongly against military service, is relatively small. If preferences are distributed logistically, the retention model can be estimated using the maximum likelihood technique known as logit.

Using the logit model, retention can be estimated using the equation

$$r = \frac{1}{1 + \exp^{(B*ACOL+\gamma}}$$

where r_i represents the probability of individual I remaining in the military, B and γ are parameters to be estimated, and X is the vector of individual characteristics.

Warner and Goldberg estimated the expected military pay stream by calculating promotion probabilities by years of service (YOS) and pay grade. Post-service earnings were estimated from data on enlisted personnel who left the Navy after one term of service. The post-service earnings function included personal characteristics, such as education, race, branch of service, and both linear and quadratic terms for years of post-service experience. In estimating retention models for 16 Navy enlisted occupation codes, Warner and Goldberg found "that variation in ACOL explains much of the variation in the probability of reenlisting." They found that for most first-term Navy enlisted personnel, the maximum ACOL, max A_n, is found over a four-year reenlistment. Only using a 10 percent discount rate (p=.1), which they believe to be too low for enlisted personnel, do Warner and Goldberg find ACOL values calculated over a horizon of 20 years of service (where retirement benefits are vested) to be greater than ACOL values calculated over four more years of service. Furthermore, married individuals have a higher reenlistment rate than single personnel. They speculate this is due to the greater value of non-monetary benefits available to married personnel, primarily the health care benefits for their dependents.

Although Warner and Goldberg's model examined the retention decisions of enlisted personnel, it also can be applied to the officer community, with some modification. The main difference between officer and enlisted retention decisions involves the period of future service. Enlisted personnel reenlist for a fixed number of years, specified in the reenlistment contract. Officers are required to complete a

minimum service requirement (MSR), such as six years after completion of flight training. After completion of the MSR, an officer can choose to separate at any time. One similarity between the two groups, however, is that both officers and enlisted personnel must examine expected pay streams over some future period to determine the benefits and cost of staying.

B. APPLICATIONS OF THE ANNUALIZED COST OF LEAVING MODEL

In his study on the effect of selected reenlistment bonuses on the retention of Marine Corps enlisted personnel, Cymrot (1987) uses the ACOL approach to predict retention. As expected, Cymrot found that increases in reenlistment bonus amounts increase retention. His findings also show that military rank is positively correlated with retention; specifically, the higher the rank of the enlisted Marine, the more likely he is to remain in the Marine Corps. This is consistent with the ACOL model in that higher-ranking individuals are paid more than lower ranking individuals and, in addition, they have demonstrated a preference for military life by staying the additional years required to achieve their rank.

Smith et al (1991) in a study of Army enlisted retention decisions using a variation of the ACOL model, called the ACOL-2 model, emphasize the extent of use of the ACOL model. They state, "because theoretical advantages are combined with relatively straightforward estimation, the ACOL model is the most commonly used approach in reenlistment modeling." Smith et al estimated military pay streams, taking promotion times into account, by including basic pay, housing pays, and sustenance pay. They did not include special pays, such as parachute jump pay, due to the inconsistent payment of the majority of the special pays. Civilian earnings were computed to age 65, defined as a standard retirement age, to avoid the complications of civilian retirement earnings and possible social security earnings.

Using their estimation of future military and civilian earnings and a discount rate of 10 percent, Smith et al found that an individual's maximum ACOL value "involves completing a military career through 20 year of service," which is the point of retirement benefits vesting. They estimate that soldiers with dependents have a higher probability of reenlisting than single soldiers. This is due to their higher monetary compensation, in the form of a greater housing allowance, and greater non-monetary benefits, such as medical care for dependents and subsidized day care. They also found that black soldiers, and to a lesser extent other minority soldiers, are more likely to reenlist than white soldiers.

C. REVIEW OF PERSONAL DISCOUNT RATE STUDIES

An important factor in the ACOL model is the individual's discount rate, p, which affects the present values of all future earnings streams. Smith et al (1991) state, " a lower discount rate, besides raising the average ACOL value, gives more weight to the post-service differences in the military and civilian pay streams, and to retirement pay."

Warner and Pleeter (1995) define the personal discount rate as "the rate at which individual's trade current dollars for future dollars," and as " the rate at which an individual discounts money streams in decisions involving choices over time." Their analysis of prior discount rate studies finds that:

1. Individuals do not discount all future values at the same rate. Their research shows discount rates to be high for small sums of money and lower for large sums. Specifically, Warner and Pleeter cite Gilman (1976) who found discount rates ranged from about 16.2 percent for young individuals with low incomes to 8.5 percent for older persons with high incomes. In similar research, Warner and Pleeter quote Black (1984) who estimated discount rates of officers and enlisted. Black estimated

officers have an average discount rate of 10.3 percent and enlisted have an average discount rate of 12.5 percent.

2. Discount rates vary with personal characteristics. It is common for discount rates to decline as age, education and income increase. In the context of military service, this supports the belief that officers, who are on average older, better educated, and paid at a higher rate, have lower discount rates than enlisted personnel.

In their study on separation incentives in the Navy, Warner and Pleeter estimated an average real discount rate for officers of 15.5 percent. The real discount rates ranged between 8 and 20 percent. Warner and Pleeter find that officer discount rates are on average 10 percentage points lower than enlisted discount rates.

Nord and Schmitz (1985) state, "the higher an individual's discount rate, the more strongly he or she prefers current to future income and, conversely the less he or she cares about changes in the expected value of future income." Nord and Schmitz cite several previous studies that estimated discount rates ranging between 1.2 and 30 percent. These estimates are displayed in Table 2.1.

Table 2.1. Nord and Schmitz Results of Previous Studies on Estimated Discount Rates

Study	Discount Rate
Friedman (1957)	30%
Landsberger (1971)	9-27%
Heckman (1976)	18-20%
Rosen (1976)	7.2-8.7%
Hausman (1979) Air Conditioner Purchases	10-39%
Leffler and Lindsay (1981) Applications to Med School	10%

Table 2.1 (Continued)

Study	Discount Rate
Gilman (1976) Decisions to participate in pension plans	1.2-24%
Cylke, Goldberg, Hogan, Mairs (1982) Response to lump sum vs. installment reenlistment bonuses in the Navy	16-20%
Black (1983)	12.5%

Cylke et al (1982) find that Navy enlisted personnel have a discount rate of approximately 17 percent, and state that most previous analysis requiring use of discount rates have erroneously used discount rates in the area of 10 percent for enlisted personnel. Using Warner and Pleeter's findings that officers have discount rates approximately 10 points lower than enlisted, the Cylke et al study would imply that officers have personal discount rates of 7 percent.

D. REVIEW OF AVIATION BONUSES

Beginning in January 1989, the Navy replaced the Aviation Officer Continuation Program (AOCP) with the Aviation Continuation Pay (ACP) program. ACP is a monetary compensation tool used to retain mid-grade aviation officers. As Navy aviators complete their initial minimum service requirement, generally between the sixth and seventh year of service, they are eligible to leave the Navy. As more and more aviators choose to leave, critical shortages of mid-grade Lieutenant Commanders, who serve as aviation squadron department heads or officers in charge began to develop in certain aviation communities. ACP bonuses are offered to communities with projected shortages. The size of the bonus depends on the

projected shortage of the aviation sub-community in question. Currently, the maximum bonus allowed by law is $12,000 a year.

The ACP bonus is offered to aviators in selected communities with six to twelve years of service. Aviators have two options, the long-term and short-term choices. By accepting a long-term contract, the aviator obligates himself to stay until the end of the 14th year of service, long enough to fill the critical mid-grade LCDR shortage. The payment, up to $12,000 per year of service specified in the contract, can be received in one of two ways: (1) either as a lump sum of 50 percent of the total value of the payment paid at the time of the contract, with the remainder is paid in equal yearly payments over the life of the contract, with the last payment received at the time of the expiration of the obligation, or (2) in equal yearly payments beginning on the date of the contract and ending at the expiration of the obligation. For example, an aviator at the start of the eighth year of service who accepts a long term contract of $12,000 per year would receive a total of $84,000 (7 * $12,000) for a commitment of 7 more years of service. Of this amount, $42,000 would be received at the commencement of the contract, with seven additional annual payments of $6,000 each if the aviator chose the first option. They could also opt for 7 annual payments of $12,000 each.

The short-term contract is offered for contract obligations of one or two years. These contracts are valued at half the yearly rate of the long term contracts in the same community and are paid in equal yearly installments, beginning at the date of the contract and ending at the end of the contract. Appendix A shows the ACP offers for the years studied in this report. As can be seen in Appendix A, ACP is primarily offered to jet pilots. In addition to having the greatest shortages of mid-grade LCDRs, jet pilots have the most extensive training and replacement cost. (This will be addressed in Chapter IV).

The other aviation bonus is the Aviation Career Incentive Pay (ACIP), commonly referred to as monthly flight pay. ACIP covers the first 25 years of service, but it affects more than just the critical mid-grade aviators. ACIP is payed to all aviators, both pilots and NFOs, regardless of their community. The schedule of ACIP payments is shown in Table 2.2. As can be seen in Table 2.2, ACIP reaches its maximum value of $650 a month at the six-year point in an aviator's career. This six-year point coincides with the point at which Naval aviators are beginning to complete their minimum service requirement (MSR) incurred from flight training. At the 18+ year point, the monthly value of ACIP begins to decrease.

Table 2.2. Aviation Career Incentive Pay (ACIP) Monthly Payment Amounts by Years of Aviation Service

Years of Aviation Service	Monthly ACIP Payment Amount
2 or less	$125
over 2	$156
over 3	$188
over 4	$206
over 6	$650
over 18	$585
over 20	$495
over 22	$385
over 25	$250

Source: 1992 Navy Pay Table

III. DATA AND METHODOLOGY

A. DESCRIPTION OF DATA

In order to analyze the separation decisions of Navy aviators, data was collected from the Defense Manpower Data Center (DMDC) in Monterey, CA. Data on all active duty and active duty reserve aviation officers was taken from the 1990, 1992, 1993, and 1994 Officer Master Files (OMF). Additional data on this same population was taken from a unique data base examining Navy aviators developed by Turner (1995). These two databases were merged to develop the final working data set, which had a total sample size of 47,166 observations covering years 1990, 1992-1994.

A number of restrictions were imposed on the data. Officers with more than 4 years of prior enlisted service were removed to eliminate demonstrated preference or taste for military life that may not compare to that of the typical newly-commissioned officer. Additionally, officers with more than 4 years of prior enlisted service are paid at higher basic pay than their counterparts without prior service, so their expected military pay will be higher than their peers of equal rank and years of service. Female aviators were also deleted from the sample. One reason for this deletion is that women represent only 1.8 percent of the total aviation population.

Only active duty Navy pilots and flight officers with designators 1310, 1315, 1320, and 1325 are the subject of this thesis. Thus, aviators in training, aviators with training and administration of reserve designator (TAR) and, general aviation officers (such as meteorologist) were excluded from the sample.

Consistent with the assumption used by Goldberg (1982), we assume that the individual's decision to remain in the military involves the decision of leaving now or staying until 20 years of service in order to receive military retirement pay. If an

individual chooses to separate from the military, he will leave immediately. Consequently, aviators with 20 or more years of service were removed from the sample population.

Aviators with less than six years of service were removed from the sample. The majority of aviators are still obligated to military service under minimum service requirements (MSR) incurred during flight school until the sixth year of service (Cymrot (1989)). All aviators still under this initial minimum service requirements (MSR) or obligated by previous ACP contract are unable to make a voluntary stay or leave decision and thus were deleted from the data set.

Aviators whose age was less than 25 at six years of service or whose age at 20 years of service (retirement eligibility) is greater than 53 were discarded from the sample. This restricts the age of entry into the Navy to a range from 19 to 33 years old. Finally, aviators with missing or incomplete data and aviators who left the Navy prior to the years observed were removed from the sample.

The restrictions listed above reduced the original sample of 47,166 to 15,832 observations. These remaining observations consist only of individuals who are "at-risk," that is, are eligible to make a voluntary retention/separation decision. Table 3.1 shows some descriptive statistics for the final sample of aviators. On average, those who left the Navy were younger, had fewer years of service, were less likely to be married and had fewer dependents than those who chose to stay in the Navy. Minority representation is slightly lower in the set of aviators who chose to remain in the Navy. The retention rate for this population of at-risk aviators was 92.6 percent.

Table 3.1 Mean Values of Selected Variables of "At-Risk" Navy Aviators, in Years 1990, 1992-1994

	Total Population Sample	Leavers	Stayers
Age	34.97	31.34	35.26
Retirement Age	43.25	-	41.19
Years of Service	11.71	7.32	12.06
Marital Status (%)	83.7%	70.5%	84.7%
Dependents	2.05	1.35	2.10
Minority (%)	3.2%	5.51%	3.10%
Sample Size	15,832	1,179	14,653

Source: DMDC and Turner(1995).

B. MODEL DEVELOPMENT

The empirical model follows the literature reviewed in Chapter II and adopts the utility maximization framework of the ACOL model in explaining the retention and separation decisions of Navy aviators. The variables used in this analysis are presented below. These variables were assumed to significantly affect an aviator's decision to stay or leave the Navy.

1. Variable Construction and Definitions

a. The Dependent Variable

The dependent variable STAY was constructed from the separation date (Sepdate) and the date of separation (DOS) variables in the final data set. If an individual aviator left the Navy during the period studied, then STAY was coded 0. If the individual aviator chose to stay in the Navy then STAY was coded 1.

b. Calculation of the ACOL Variable

To compute the Annualized Cost of Leaving (ACOL) it was assumed that individuals form their expectations of future earnings based on information about expected future military pay and promotion opportunities if they stay and expected future civilian earnings potential if they leave. Since military retirement is not offered until a service member reaches 20 years of service, it is assumed that when an individual decides to stay in the military he will serve until 20 years then leave with retirement benefits and pursue a civilian career. This follows the assumption used by Goldberg (1982) in his study of mid-career (third term) enlisted personnel. Furthermore, all dollar values used in this analysis have been converted to 1991 values using the Consumer Price Index (CPI) values contained in the Economic Report of The President (1995).

To calculate estimated military pay until retirement, a pay grade distribution by years of service for aviators was created using the 1992 Officer Master File from DMDC. The resulting probability of being in a certain rank by year of service was combined with the 1991 military pay table to obtain expected monthly basic pay, basic allowance for quarter (BAQ) conditioned on dependent status, federal insurance contribution act (FICA) deductions, and monthly aviation career incentive pay (ACIP). Following Warner and Goldberg (1984) special pays were not included in computing military pay because they are small relative to basic pay, BAQ, and aviation bonus pays, and are designed as a compensating wage differential for undesirable job characteristics of certain military duties.

To determine the value of Aviation Continuation Pay (ACP), all Naval aviators who were eligible to receive ACP in the years examined were assumed to include the maximum amount of ACP allowed when considering their future military pay stream. It was also assumed that as utility maximizing individuals, all ACP-

eligible aviators would choose the 50 percent lump-sum followed by equal annual installment payments option over the equal payments option in order to maximize the present value of the ACP payments. Expected future military retirement pay was calculated as 50 percent of an individual's expected base pay at 20 years of service.

The present value of the total military pay stream associated with staying until 20 years of service is represented by summing the discounted values of annual military pay, including ACIP and ACP, until 20 years of service and the values of military retirement pay from the age of retirement until age 65. Military retirement pay and later, civilian earnings were computed until age 65, not until life expectancy, T, as in Warner and Goldberg (1984). This was done to reduce computational complexity and because of the difficulty of determining civilian retirement payments and social security benefits received from age 65 until death. Following Cylke et al (1982), Goldberg (1982) and Warner and Goldberg (1984), a discount rate of ten percent was used throughout the analysis.

A military retiree was assumed to join the civilian labor market and work until retirement age of 65. To obtain a civilian age-earnings profile for this period we used data from the 1990 Public Use Microdata Sample (PUMS) from the decennial census of the United States. The PUMS data contains records representing a 5 percent sample of the housing units in the United States and the persons in them and was prepared by the Bureau of the Census. The sample population was restricted to only male military veterans. Furthermore, these veterans must have had a college degree or greater education, to approximate officer status. Controlling for age, marital status and whether or not the individual received military retirement benefits, an age-earnings profile was calculated to estimate expected future civilian earnings until age 65. The present value of civilian income after military retirement is the sum of the discounted annual civilian pay from age at military retirement until age 65.

The present value of the military pay stream and post-retirement civilian earnings were summed to get an individual's estimated monetary value of staying in the military.

The same age-earnings profile was used to compute the expected annual civilian earnings for individuals who choose to leave the military before 20 years of service. Consistent with Warner and Goldberg (1987), service members who leave prior to 20 years of service have higher predicted civilian earnings than those individual who stay until retirement (20 YOS). Discounting an individual's annual civilian income and summing these values from current age until age 65 provides the estimated present value of the civilian income stream if an individual were to leave the military immediately.

The cost of leaving (COL) value was calculated for each individual as the difference between the present value of staying in the military for 20 years and the present value of leaving the military immediately. This is summarized in the following formula: COL = (Present Value of military pay + military retirement pay + post-retirement civilian earnings) - (present value of civilian earnings if individual leaves immediately). The COL values were annualized using the 10 percent discount rate, conditioned on the number of years remaining until 20 years of service. It is hypothesized that ACOL is positively correlated with the probability of staying. In other words, all else equal, the higher the ACOL value, the more likely an individual is to remain in the military.

c. *Demographic Variables*

Demographic variables are included in the retention model to capture effects of non-monetary factors affecting the individual's net taste for a civilian lifestyle. The following section describes the construction of these variables and their hypothesized effect on retention.

(1) **MARRIED**. A dummy variable indicating marital status coded 1 if and individual is married and 0 otherwise. Although marital status was included in computation of the ACOL value, it also was included in the retention decision model to account for benefits, such as health care for the individual's spouse, that differ between married and single service members. It is expected that being married (Married = 1) is positively related to the decision to stay in the military.

(2) **NODEP**. NODEP (number of dependents) is a continuous variable for the number of dependents. It is assumed that the greater the number of dependents an individual has, the more the individual values steady military pay and fringe benefits over the civilian sector. As mentioned in Chapter II, the non-monetary value of military service, specifically health care benefits, increases with the number of dependents. Therefore, it is hypothesized that NODEP is positively correlated with retention, i.e., as NODEP increases, so does an individual's likelihood of remaining in the military.

(3) **MINORITY**. MINORITY (non-white, member of racial minority). A dummy variable coded 1 if the individual is a racial minority and coded 0 if the individual is Caucasian. Because the proportion of aviators who are minorities is small, this factor may be inconsequential in determining potential civilian earnings. However, civilian earnings for minorities tend to be lower, on average, than civilian earnings of non-minorities. This being the case, minorities are estimated to have higher ACOL values than non-minorities. Therefore, it is hypothesized that minority status will be positively related to remaining in the military.

C. MODEL SPECIFICATION

Given the above variable descriptions, an aviator's decision to stay or leave the Navy is modeled using the following logit equation: Equation 3.1:

$$STAY = \alpha_0 + B_1 ACOL^{+} + B_2 MARRIED^{+} + B_3 NODEP^{+} + B_4 MINORITY^{+}$$

where the signs indicate the expected relation between the independent variable and the dependent variable (STAY).

IV. EMPIRICAL RESULTS

This chapter presents the results of the empirical analysis and discusses the estimation methods used.

A. METHODS

Equation 3.1 was used to predict retention rates in response to bonus effects. The results are estimated by determining the average effect of the financial incentives, such as an increase in aviation bonus pay, on retention rates. For each individual Naval aviator in the sample, the probability of retention is predicted using the estimated logit model in equation 3.1 with the dollar value of the hypothetical increase in ACIP or ACP included in the ACOL value. This gives the individual's probability of staying when the financial incentive is included in the ACOL computation. We can also simulate the probability of staying when the additional bonus amount is not included in the ACOL variable. By taking the difference in the retention probabilities between these two states, an individual's net change in the probability of retention, due to the additional bonus pay, can be determined. The average effect of a particular bonus amount can be calculated for the entire sample using the following formula.

Equation 4.1:

$$\Delta P = \frac{\sum_{i=1}^{n} (P_{1i} - P_{2i})}{n}$$

where P_{1i} is an individual's simulated probability of staying (from equation 3.1) with the inclusion of an increase in bonus pay in the ACOL variable, and P_{2i} is an individual's probability of staying (from equation 3.1) without including the increase

in bonus pay in the ACOL value, and n equals the number of observation in the sample.

In addition to average program effects, the effect of changes in one's demographic characteristics were simulated using the notional person approach. Unlike linear probability models, such as ordinary least squares (OLS), logit coefficients are difficult to interpret. That is, in a linear probability model, the estimated coefficient gives the effect of a one unit increase in an independent variable on the change in probability of the outcome. In a logit model, the coefficients of the independent variables represent the logarithm of the odds ratio of the dependent variable. To interpret the logit model, a unit change in an independent variable must be examined at the mean values of the independent variables. This is done by constructing a notional or "representative" person. This is a fictitious individual whose values for continuous independent variable are set at the mean, or average, values for the entire sample. Values for dummy/dichotomous variables are set at 0 or 1, depending on which value represents the majority of the sample. Holding all else constant, the effect of a continuous variable on the independent variable being estimated is determined by increasing its mean value by one unit. For dummy variables, the notional value is changed from 0 to 1, or 1 to 0, depending on which value is used in the notional person. By taking the difference between the notational (average) value and the "new" value of the explanatory variable, the change in probability for the dependent variable can be calculated.

B. RESULT OF MODEL

Table 4.1 provides the average ACOL value and retention rate for each year of commissioned service (YCS) cell in the data.

Table 4.1. Average ACOL Values and Actual Retention Rates by Years of Commissioned Service (YCS)

YCS	Observations	Average ACOL ($)	Retention Rate (%)
6	2,007	$ 17,599	76.6
7	2,745	$ 18,743	82.6
8	1,390	$ 18,022	92.8
9	766	$ 18,061	96.1
10	610	$ 17,332	96.7
11	555	$ 17,453	98.2
12	512	$ 18,103	99.8
13	601	$ 20,200	99.8
14	1,017	$ 23,492	99.3
15	1,162	$ 27,865	97.8
16	1,107	$ 33,443	97.8
17	1,023	$ 43,253	99.3
18	1,145	$ 62,164	99.6
19	1,190	$121,163	100
TOTAL (mean)	15,830	$ 32,863	92.6

Data sources: DMDC and Turner (1995).

As can be seen in Table 4.1, ACOL values are fairly constant from years of service 6 to 12, with a maximum difference of $1,411, and the lowest retention rates are observed in years of service 6 and 7. This corresponds to the period in which a majority of aviators complete their initial minimum service requirement (MSR)

incurred in flight training. From years of service 13 to 19, ACOL values increase rapidly and retention rises from 92 to 100 percent. This is due to the increased attractiveness of the military retirement system as an individual draws closer to the 20 year milestone. Furthermore, an individual's discount factor used in converting the COL to ACOL decreases as 20 years of service approaches. Overall, the mean, or average ACOL value is $32,863, and the mean retention rate is 92.6 percent.

Table 4.2 shows the results of estimating the logit regression model.

Table 4.2. Logit Regression Results for Retention of Navy Aviators with 6 to 19 YOS

Variable	Coefficient	Wald Chi-square	Pr> Chi-square	Notional Value
INTERCEPT	-0.4211	10.59	0.0011*	-0.4211
ACOL	0.00009	331.29	0.0001*	$32,864
MARRIED	0.6850	47.09	0.0001*	1
NODEP	0.2606	58.48	0.0001*	2.05
MINORITY	-0.3184	5.05	.0246**	0.00

Model Chi-square = 565.057 with 4 DF (p=0.0001)
* significant at the 99% confidence level
** significant at the 95% confidence level

All the variables in the estimated equation are statistically significant at the 95 percent confidence level (or better).

C. EFFECTS OF DEMOGRAPHIC VARIABLES ON RETENTION

Using the notional person approach discussed in section 4.A and the mean values presented in the last column of Table 4.2, the effects of the demographic variables MARRIED, NODEP, and MINORITY on retention are examined below. We examine the effect of the ACOL variable in the next section.

MARRIED. Changing the notional value from 1 to 0, or from married to not married, holding all else constant, results in an estimated decrease in retention of 2.14 percent. This agrees with prior expectations in Chapter III section C. Benefits in kind, higher basic pay and housing allowances, and the increased value of services offered to spouses, such as medical care, all serve to increase a married individual's preference, or "taste", for a military lifestyle over a non-married individual's "taste" for a military lifestyle.

NODEP. Similar to MARRIED, an increase in the number of dependents for a Naval aviator, holding all else constant, is estimated to increase retention by 0.512 percent at the mean or average observation. Again, greater benefits, primarily health care, are thought to raise the "tastes" for military life of aviators with dependents. This agrees with prior expectations.

MINORITY. Contrary to expectations in Chapter III, being a minority was found to decrease retention by 0.826 percent. This could be due to differences in the net preference for a civilian life across racial lines. Minority aviators may have, on average, a higher net preference for civilian life than non-minority aviators.

D. RESULTS OF CHANGES TO BONUS PAYS

This section examines the effect of changes in aviation bonus pays on retention. This is done using the average treatment effect introduced in section 4.A by including and excluding the hypothetical bonus value in the calculation of the ACOL variable. Section 1 shows the effect of increasing ACIP by $50. Sections 2, 3, and 4 show estimated results of increasing ACIP by $100, doubling ACP, and eliminating ACP, respectively.

1. Simulated Effect of Increasing ACIP Maximum Payment by $50 from $650 to $700 a Month

The average treatment effect method was used to determine the effect of increasing Aviation Career Incentive Pay (ACIP) by $50 monthly from a maximum amount of $650 to $700 a month. Using the logit regression results in Table 4.2, the average treatment effect of this $50 per month increase in ACIP in presented in Table 4.3.

Table 4.3. Average Treatment Effect Analysis of an Increase of the Maximum ACIP from $650 Monthly to $700 Monthly

Baseline retention rate without increase in ACIP	92.55%
New retention rate with $50 increase in monthly ACIP	92.76%
Net Increase in retention	+0.21%

Source: DMDC and Turner (1995). Calculations by author.

Taken over the sample of 15,830 Naval aviators, of which 14,651 remained in the Navy (92.6%) and, 1,179 (7.4%) separated, this equates to 31 aviators, or 2.63 percent of those who separated. That is, 31 aviators, who otherwise would have left the Navy, were induced to stay by the $50 monthly increase in ACIP.

2. Simulated Effect of Increasing ACIP Maximum Payment by $100 from $650 to $750 a Month

Again, using the average treatment effect method and the logit results from Table 4.2, the effect of increasing the maximum monthly ACIP by $100 from $650 to $750 a month is shown in Table 4.4. Taken over the sample of 15,830 Naval

aviators, of which 14,651 remained in the Navy (92.6%) and, 1,179 (7.4%) separated, this equates to 64 aviators, or 5.51 percent of those who separated, who otherwise would have left the Navy but were induced to stay by the $100 monthly increase in ACIP.

Table 4.4. Average Treatment Effect Analysis of an Increase of the Maximum ACIP of $650 Monthly to $750 Monthly

Baseline retention rate without increase in ACIP	92.55%
New retention rate with $100 increase in monthly ACIP	92.99%
Net Increase in retention	+0.44%

Source: DMDC and Turner (1995). Calculations by author.

3. Simulated Effect of Doubling the Aviation Career Pay (ACP) Bonus

Using the average treatment effect method and Table 4.2 logit regression results, the effect of doubling the ACP payment amounts on retention are shown in Table 4.5. Appendix A shows the amounts of ACP by aviation community. Taken over the sample of 15,830 Naval aviators, of which 14,651 remained in the Navy (92.6%) and, 1,179 (7.4%) separated, this equates to 92 aviators in the ACP-eligible communities, or 7.63 percent of those who separated, who otherwise would have left the Navy but were induced to stay by the doubling of ACP.

Table 4.5. Average Treatment Effect Analysis of Doubling ACP Amounts

Baseline retention rate without doubling ACP bonus amounts	92.55%
New retention rate acp bonus amounts doubled	93.18%
Net Increase in retention	+0.63%

Source: DMDC and Turner (1995). Calculations by author.

4. Simulated Effect of Eliminating the Aviation Career Pay (ACP) Bonus

Using the average treatment effect method and Table 4.2, the effect of eliminating the ACP payment altogether (shown in Appendix A) on retention is shown in Table 4.6. This is shown to illustrate the effectiveness of the existing ACP program.

Table 4.6. Average Treatment Effect Analysis of Eliminating ACP Payments

Baseline retention rate without doubling ACP bonus amounts	92.55%
New retention rate acp bonus amounts doubled	91.38%
Net Increase in retention	-1.17%

Source: DMDC and Turner (1995). Calculations by author.

Taken over the sample of 15,830 Naval aviators, of which 14,651 remained in the Navy (92.6%) and, 1,179 (7.4%) separated, this equates to 172 aviators in the ACP-eligible communities, or 14.59 percent of those who stayed, who otherwise would have remained in the Navy under an ACP contract are estimated to separate from the Navy.

E. COST-BENEFIT ANALYSIS

Unlike the previous section, where the effects of changes to bonus pays were examined for the entire sample of Naval aviators eligible to separate from 1990 - 1994 (excluding 1991), this section examines the effects of changes to aviation bonus pays for only one year, 1992. This year was chosen because, of all the years studied, 1992 had the largest number of aviators accepting Aviation Continuation Pay (ACP), and therefore was the most expensive year for that program. Overall, the 1992 data sample had 3,920 observations, of which 3,571, or 91.1 percent remained in the Navy. The remaining 349 Naval aviators, or 8.9 percent, separated from the Navy during the period; 355 of these 3,920 individuals entered into an ACP contract in 1992.

To evaluate the economic efficiency of projected effects of changes to aviation bonus pays, a cost-benefit analysis is conducted. The cost of increasing either ACIP or ACP is compared to the cost of training an aviator. The cost savings from aviators who are induced to stay is considered the benefit of the program. If the costs associated with training a replacement for an aviator who separates are greater than the cost of the increase in bonus pay, then the increase in bonus pay will be judged to be cost-effective. On the other hand, if the cost of increasing the bonus pay is less that the cost of training the aviator, then the increase in bonus pay is not cost effective.

Morrissey and Cylke (1990) attempted to determine the average and marginal costs of training Navy pilots. Average cost of training was defined as the total of all

pilot training cost, divided by the number of pilots trained. This included all fixed and variable costs, such as airfield maintenance and aircraft repair costs, budgeted for pilot training. Marginal cost of training a Navy pilot is defined as

> those costs which will change with a given change in the number of pilots trained. Unlike average cost, marginal cost will normally exclude fixed and overhead costs since they would not be affected by small changes in the pilot training rate.

Morrissey and Cylke determined the minimal marginal cost of training one additional pilot in the undergraduate and graduate training pipelines. Undergraduate flight training is the initial training, whereas graduate flight training is defined as completing the first advanced flight training in a specific fleet aircraft, (called CAT I training) and subsequent refresher training in the fleet aircraft for a pilot who has previous fleet experience (1 or more tours) in that aircraft (called CAT II training). Table 4.7 presents Morrissey and Cylke's calculated marginal and average cost figures for pilot training by type of aircraft.

Table 4.7. Marginal and Average Cost of Navy Pilot Training by Aircraft Type

Marginal costs are shown above Average costs, which are in (parenthesis).

Aircraft Type	Undergrad Training	CAT I Graduate Training	CAT II Graduate Training	Total Marginal Cost	Average Cost
F-14	$485,151 ($713,038)	$457,922 ($673,145)	$405,205 ($595,651)	$1,348,278	$1,981,834
F/A-18	$485,151 ($713,038)	$421,806 ($620,055)	$350,856 ($515,758)	$1,257,813	$1,848,851

Table 4.7 (Continued)

Aircraft Type	Undergrad Training	CAT I Graduate Training	CAT II Graduate Training	Total Marginal Cost	Average Cost
A-7	$485,151 ($713,038)	$423,312 ($622,269)	$311,269 ($457,565)	$1,219,732	$1,792,872
A-6	$485,151 ($713,038)	$428,672 ($630,148)	$281,582 ($414,323)	$1,195,676	$1,757,509
S-3	$485,151 ($713,038)	$242,727 ($356,808)	$188,274 ($276,763)	$916,152	$1,346,609
P-3	$151,583 ($199,866)	$127,549 ($168,365)	$114,113 ($150,629)	$393,515	$518,860
E-2	$151,583 ($199,866)	$253,689 ($334,869)	$295,383 ($389,906)	$700,925	$924,641
H-3	$165,869 ($213,937)	$188,661 ($243,373)	$146,777 ($189,342)	$501,307	$646,652
H-2	$165,869 ($213,937)	$177,697 ($229,229)	$148,590 ($191,681)	$492,156	$634,847
H-60	$165,869 ($213,937)	$138,241 ($178,331)	N/A N/A	$304,110	$392,268
H-53	$165,869 ($213,937)	$292,732 ($377,624)	$239,411 ($308,840)	$698,012	$900,401

Source: Morrissey and Cylke (1990).

Using the total marginal cost and the total average cost of training Navy pilots in Table 4.7 and the number of aviators in each aircraft community (as of 1992), the weighted-average marginal cost of training a Navy pilot aviator is $759,186 and the weighted-average average cost of training a Navy pilot is $1,073,602. Note that Morrissey and Cylke did not determine NFO training cost. However, for this study,

NFO training cost are assumed to be equal to pilot training cost even though NFO training costs are probably lower than pilot training costs because NFOs spend less training time in the aircraft (the most costly portion of training). Note that the marginal and average costs computations do not account for the cost of attrition during the entire training process. Attrition is factored into the undergraduate training cost but not the graduate training cost. Morrissey and Cylke state,

> to obtain one successful completion at the end of the undergraduate training pipeline requires that more than one trainee start at the beginning. Depending on the stage in which trainee attrition occurs, the cost of this loss can be significant (larger).

By using the weighted-average of the marginal training cost as a lower-bound cost estimate, and the weighted-average of the average training cost as an upper bound cost estimate, a sensitivity analysis of increases in the ACIP or ACP program can be determined. If the ACIP and ACP program effects are cost-beneficial using these deliberately conservative training cost estimates, then we can be more confident that the programs are truly cost-effective (e.g., when full replacement costs have been included.)

Section E.1 presents the cost-benefit analysis of simulating raising the maximum monthly ACIP from \$650 to \$700 for the 1992 sample of aviators. Sections 2 and 3 show the cost-benefit analysis of increasing ACIP by \$100, and of doubling ACP payments for the 1992 sample of aviators, respectively.

1. Cost-Benefit Analysis of Increasing ACIP Maximum Payment from \$650 to \$700 a Month Using the 1992 Sample

Using only the Naval aviators eligible to separate from the Navy in 1992, and applying regression results from Table 4.2 to determine the average treatment effect, a \$50 increase in the maximum monthly ACIP from \$650 to \$700 induces 8 Naval

aviators who otherwise would have left the Navy to choose to stay in. Using an upper-bound estimate of 10,000 aviators who would receive this additional $50 monthly increase in ACIP, the additional cost to the Navy of implementing this new bonus would be $5,000,000. However, the training cost of the 8 Naval aviators induced to stay by the bonus, using both lower and upper-bound values is $6,073,488 (= $759,186 * 8) to $8,588,816 (= $1,073,602 * 8). This yields a net benefit of $1,073,488 in favor of increasing the maximum ACIP monthly payment by $50 using the lower-bound training cost and a net benefit of $3,588,816 using the upper-bound training costs. The break-even training cost, which is the training cost that drives the net benefit to zero is $625,000. Since all of the training cost estimates exceed this amount, we are fairly confident that this proposed program is cost effective.

2. Cost-Benefit Analysis of a $100 Monthly Increase in the Maximum ACIP from $650 to $750, Using 1992 Data

Using only the Naval aviators eligible to separate from the Navy in 1992, and applying Table 4.2 to determine the average treatment effect of a $100 increase in the maximum ACIP monthly payment from $650 to $750, results in inducing 16 Naval aviators who otherwise would have left the Navy to choose to stay in. Using a upper-bound estimate of 10,000 aviators who would receive this additional $100 a month increase in ACIP, the additional cost to the Navy of implementing this bonus increase would be $10,000,000. However, the training cost of the 16 Naval aviators induced to stay by the bonus is $12,146,976 (= $759,488 * 16) using lower-bound costs and $17,177,632 (= $1,073,602 * 16) using upper-bound costs. This yields a net benefit of $2,146,976 in favor of increasing the maximum ACIP monthly payment by $100 when the lower-bound cost is used and $7,7177,632 when the upper-bound cost is used. Again, the break-even training cost of a $100 monthly increase in ACIP is $625,000, the same as in the simulation of the $50 a month increase in ACIP.

3. Expected Affects of Doubling ACP on the 1992 Sample of Naval Aviators Eligible to Separate from the Navy

Using only the Naval aviators eligible to separate from the Navy in 1992, and applying Table 4.2 regression results to determine the average treatment effect of doubling ACP payment amounts induces 39 Naval aviators, in the ACP eligible communities, who otherwise would have left the Navy, to stay in. Prior to doubling ACP payment amounts, the non-discounted program cost for the 355 Naval aviators who accepted an ACP contract was $13,289,000 with a mean total payment of $37,434 per individual. After doubling ACP payments for these 355 aviators and for the additional 39 aviators induced to stay by the higher ACP bonus, program cost becomes $29,497,836, an increase of $16,208,836. The cost of training the 39 aviators who otherwise would have left the Navy is $29,608,254 (= $759,488 * 39) if the lower-bound training cost is used. This yields a net benefit of $13,399,418 in support of doubling ACP payments. If upper-bound training cost figure is used, the cost of the 39 aviators who otherwise would have left the Navy is $41,870,478 (= $1,073,603 * 39). This yields a net benefit of $25,661,642 in favor of doubling ACP amounts. Bear in mind that due to attrition of aviation trainees, both lower-bound and upper-bound training cost are less the replacement cost of Naval aviators. If a higher replacement cost value used, the net cost savings would be substantially larger. The break-even training cost for doubling ACP payments is $415,611.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This thesis developed an Annualized Cost of Leaving (ACOL) model for Navy aviators. Using this framework, the effects of aviation bonus pays on aviator retention was examined. Given the statistical significance of the logit regression model used in this study, the ACOL model is a feasible approach for predicting the retention/separation decision of Naval aviators. Furthermore, financial incentives, in the form of aviation bonus pay, have a significant impact on retention of Naval aviators. Specifically, this thesis finds:

1. A \$50 monthly increase in the maximum Aviation Career Incentive Pay (ACIP) from \$650 to \$700 a month results in a predicted increase in aviator retention of .209 percent.

2. A \$100 monthly increase in the maximum Aviation Career Incentive Pay (ACIP) from \$650 to \$750 a month results in a predicted increase in aviator retention of .435 percent.

3. Doubling the yearly contract payment amounts of the Aviation Continuation Bonus Pay (ACP) is estimated to increase retention of Naval aviators by .625 percent.

By comparing the cost of increasing the ACIP or ACP programs, with the cost of replacing the Naval aviators who otherwise would have left the Navy in the absence of the increased aviation bonus pays, this thesis showed that increases in aviation bonus pays are cost effective. By examining the 1992 data set of Naval aviators, it was found that the lower bound net benefit (in the form of training cost savings) of increasing the bonus pays of aviators who would have left the Navy was:

1. Between $1,073,488 and $3,588,488 for a $50 monthly increase in the maximum ACIP from $650 to $700.

2. Between $2,146,976 and $7,177,632 for a $100 monthly increase in the maximum ACIP from $650 to $750.

3. Between $13,399,418 and $25,661,642 for doubling the ACP yearly contract payment amounts.

Bear in mind that if replacement costs, where attrition of aviation trainees is taken into account, vice training costs are used in the cost-benefit analysis, then the net benefit to the Navy from increasing aviation bonus pays would be even greater.

B. RECOMMENDATIONS

1. ACP is Preferable to ACIP

While increasing either ACIP or ACP is a cost effective way of increasing the retention of Naval aviators, this thesis recommends that increasing ACP is preferable to increasing ACIP. Increasing the maximum monthly ACIP involves paying all eligible aviators the increased bonus pay. Although this policy was shown to be cost-effective in retaining aviators, the communities of the aviators induced to stay cannot be targeted. An increase in ACIP may induce aviators to stay in communities where there is no retention problem, such as the VA (A-6 Intruder) or HSL-MkI (SH-2F Seasprite) communities. At the time of this report, the VA community is being phased out of the Navy and the HSL-MkI community has been completely eliminated. On the other hand, increasing the yearly ACP payment allows manpower planners to target specific aviation communities where retention problems are projected to exist. Additionally, the ACP program can be offered only to pilots or flight-officers, depending on where shortages are expected.

2. Further Research

Further research should continue by:

a. Determining the true replacement cost of Naval Aviators. To ensure accurate cost-benefit analysis of increasing aviation bonus programs, the true replacement cost, by community, and by pilot and NFO designator, needs to be determined.

b. Development of a data base containing observations on the post-service earnings of Naval aviators. The unique skills and experience of Naval aviators suggest that their civilian earnings potential may not be comparable to the earnings of non-aviation officers. Employment by the airlines or other aviation industries comes to mind. This would allow a more accurate determination of an individual's expected ACOL values, and thus, a more accurate determination of the effect of aviation bonus pays.

APPENDIX A. AVIATION CONTINUATION PAY

Appendix A presents ACP eligible communities and the yearly amount each contract is worth. All dollar figures listed are in nominal dollars and have not been discounted to 1991 dollars. Table A.1 shows ACP values for 1990. Tables A.2, A.3, and A.4 present values for years 1992, 1993, and 1994 respectively.

Table A.1. ACP Eligible Communities and Yearly Contract Values for 1990

Aviation Community	Short Term ACP Contract (2 years) Yearly Value	Long Term ACP Contract (to 14 years) Yearly Value
VF (pilot)	$6,000	$12,000
VF (NFO)	$3,000	$ 6,000
VAL/VFA	$6,000	$12,000
VAM (pilot only)	$6,000	$12,000
VAQ (pilot)	$6,000	$12,000
VAQ (NFO)	$3,000	$ 6,000
VAW (pilot)	$6,000	$12,000
VAW (NFO)	$3,000	$ 6,000
VS (pilot only)	$6,000	$12,000
VP (pilot only)	$5,000	$10,000
VQ (EW jet pilot only)	$6,000	$12,000
VQ (TACAMO/EP-3 pilot)	$5,000	$10,000
VQ (TACAMO/EP-3 NFO)	$3,000	$ 6,000
HC, HSL	$4,500	$ 9,000
HM, HS	$3,000	$ 6,000

Source: All Navy Message 157/89.

Table A.2. ACP Eligible Communities and Yearly Contract Values for 1992

Aviation Community	Short Term ACP Contract (2 years) Yearly Value	Long Term ACP Contract (to 14 years) Yearly Value
VF (pilot)	$6,000	$12,000
VF (NFO)	$3,000	$ 6,000
VAL/VFA	$6,000	$12,000
VAM (pilot only)	$6,000	$12,000
VAQ (pilot)	$6,000	$12,000
VAQ (NFO)	$3,000	$ 6,000
VAW (pilot)	$6,000	$12,000
VAW (NFO)	$3,000	$ 6,000
VS (pilot only)	$6,000	$12,000
VP (pilot only)	$5,000	$10,000
VQ (EW jet pilot only)	$6,000	$12,000
VQ (TACAMO/EP-3 pilot)	$5,000	$10,000
VQ (TACAMO/EP-3 NFO)	$3,000	$ 6,000
HC	$4,500	$ 9,000
HS, HSL, HM	$3,000	$ 6,000

Source: Navy Administration Message 147/91.

Note: The only difference between the 1990 and the 1992 ACP program is that in 1992 HSL pilots bonus has been lowered from $4,500 to $3,000 for a short-term contract and from $9,000 to $6,000 for a long-term contract.

Table A.3. ACP Eligible Communities and Yearly Contract Values for 1993

Aviation Community	Long-term ACP Contract (to 14 years) Yearly Value
VF (pilot)	$12,000
VFA (pilot)	$12,000
VA (pilot)	$ 9,000
VAQ (pilot)	$12,000
VAW (pilot)	$12,000
VS (pilot)	$ 9,000
VQ (EW jet pilot)	$12,000
VQ (TACAMO/EP-3 pilot)	$12,000

Source: Navy Administration Message 185/92.

Note: In 1993, short-term contracts were no longer offered. Additionally, NFO's, VP, and helicopter communities were no longer offered ACP bonuses.

Table A.4. ACP Eligible Communities and Yearly Contract Values for 1994

Aviation Community	Long-term ACP Contract (to 14 years) Yearly Value
VF (pilot)	$ 6,000
VFA (pilot)	$12,000
VAQ (pilot)	$12,000
VS (pilot)	$12,000
VQ (EW jet pilot)	$12,000
VQ (TACAMO/EP3 pilot)	$12,000
HM (pilot)	$ 9,000

Source: Navy Administration Message 215/93

Note: 1994 ACP program removed the VA and VAW communities but added the HM community, compared to the 1993 ACP program.

APPENDIX B. ESTIMATES OF THE EXPECTED MILITARY PAY

Appendix B presents the estimates of the expected military pay by YOS. Table B.1 shows the pay grade distribution, of the Naval aviators in the 1992 data sample by YOS, which was used to computed expected military pay. Table B.2 shows the values for Naval aviators receiving a maximum ACIP of $650 a month. Table B.3 and B.4 show the respective estimates when ACIP is increased to a maximum monthly amount of $700 and $750. All values are in 1991 real dollars.

Table B.1. Pay Grade Distribution of Naval Aviators by YOS

YOS	O-3, Lieutenant	O-4, Lieutenant Commander	O-5, Commander
6	100%	-	-
7	100%	-	-
8	100%	-	-
9	100%	-	-
10	58.04%	41.96%	-
11	0.71%	92.90%	-
12	-	100%	-
13	-	100%	-
14	-	95.47%	4.53%
15	-	56.86%	43.14%
16	-	28.00%	72.00%
17	-	27.41%	72.59%
18	-	29.12%	70.88%
19	-	27.50%	72.50%

Source: 1992 DMDC Officer Master File.

Table B.2. Expected Military Pay by YOS for Naval Aviators with Maximum ACIP of $650

YOS	Exp. Mil. Pay, Single Max. ACIP $650 monthly	Exp. Mil Pay, Married Max. ACIP $650 monthly
6	$35,638	$36,617
7	$42,302	$43,218
8	$42,302	$43,218
9	$43,353	$44,332
10	$44,347	$45,326
11	$47,663	$48,612
12	$47,866	$48,846
13	$49,751	$50.731
14	$49,835	$50,836
15	$52,531	$53,720
16	$53,307	$54,636
17	$55,902	$57,234
18	$55,833	$57,157
19	$57,165	$58,496
Retirement Pay	$24,484	$24,484

Source: 1992 Naval Officer Pay Table, DMDC, and Turner (1995).

Table B.3. Expected Military Pay by YOS for Naval Aviators with Maximum ACIP of $700

YOS	Exp. Mil. Pay, Single Max. ACIP $700 monthly	Exp. Mil Pay, Married Max. ACIP $700 monthly
6	$35,938	$36,617
7	$42,902	$43,881
8	$42,902	$43,881
9	$43,953	$44,932
10	$44,599	$45,578
11	$48,220	$49,199
12	$48,466	$49,446
13	$50,351	$51,330
14	$49,862	$50,863
15	$52,790	$53,978
16	$53,739	$55,068
17	$56,337	$57,669
18	$56,258	$57,582
19	$57,175	$58,496
Retirement Pay	$24,484	$24,484

Source: 1992 Naval Officer Pay Table, DMDC, and Turner (1995).

Table B.4. Expected Military Pay by YOS for Naval Aviators with Maximum ACIP of $750

YOS	Exp. Mil. Pay, Single Max. ACIP $750 monthly	Exp. Mil Pay, Married Max. ACIP $750 monthly
6	$35,638	$ 36,617
7	$43,502	$ 44,481
8	$43,502	$ 44,481
9	$44,553	$ 45,532
10	$44,851	$ 45,830
11	$48,777	$ 49,757
12	$49,066	$ 50,046
13	$50,952	$ 51,931
14	$49,889	$ 50,891
15	$53,048	$ 54,237
16	$54,171	$ 55,500
17	$56,772	$581,057
18	$56,684	$ 58,007
19	$57,165	$ 58,496
Retirement Pay	$24,484	$ 24,484

Source: 1992 Naval Officer Pay Table, DMDC, and Turner (1995).

APPENDIX C. CIVILIAN AGE-EARNINGS PROFILES FOR NAVAL AVIATORS

Appendix C presents the estimated civilian pay used in calculating the returns of leaving immediately and the expected future earning after military retirement. Tables C.1 shows the expected civilian earnings for Naval aviators who left the Navy with less than 20 years of service (retirement eligibility point) and Table C.2 shows the expected civilian earnings for Naval aviators after retirement.

Recall, that military retirement pay equal to $24,484 annually is included in calculating the post-service income stream in addition to the expected civilian earnings presented in Table C.2.

Table C.1. Estimated Annual Civilian Earnings by Age for Naval Aviators Who Leave the Military Before 20 YOS, in 1991 Dollars

The earnings function for Table C.1 is :
civilian earnings = exp(7.622541 + 0.11274*AGE - 0.001033*(AGE^2) + 0.1954 MARRIED) * (136.2/124).

AGE	Civ. Earnings, Single Naval Aviators	Civ. Earnings, Married Naval Aviators
25	$19,718	$23,974
26	$20,939	$25,458
27	$22,189	$26,978
28	$23,466	$28,529
29	$24,764	$30,108
30	$26,081	$31,709
31	$27,410	$33,325
32	$28,748	$34,952
33	$30,090	$36,583
34	$31,428	$38,210
35	$32,759	$39,828

Table C.1 (Continued)

AGE	Civ. Earnings, Single Naval Aviators	Civ. Earnings, Married Naval Aviators
36	$34,075	$41,429
37	$35,371	$43005
38	$36,641	$44,548
39	$37,878	$46,052
40	$39,076	$47,508
41	$40,229	$48,910
42	$41,330	$50,248
43	$42,373	$51,517
44	$43,354	$52,709
45	$44,265	$53,817
46	$45,102	$54,835
47	$45,861	$55,757
48	$46,535	$56,578
49	$47,123	$57,292
50	$47,619	$57,895
51	$48,021	$58,384
52	$48,327	$58,755
53	$48,534	$59,007
54	$48,641	$59,138
55	$48,648	$59,146
56	$48,555	$59,033
57	$48,362	$58,798
58	$48,070	$58,443

Table C.1 (Continued)

AGE	Civ. Earnings, Single Naval Aviators	Civ. Earnings, Married Naval Aviators
59	$47,681	$57,970
60	$47,198	$57,383
61	$46,623	$56,648
62	$45,960	$55,879
63	$45,214	$54,971
64	$44,387	$53,966
65	$43,486	$52,870

Source: Public Use Microdata Sample (PUMS) 1990.

Table C.2. Estimated Annual Civilian Earnings by Age for Naval Aviators Who Leave the Military after 20 YOS, in 1991 Dollars

The earnings function for Table C.2 is :
civilian earnings = exp(7.381707 + 0.11274*AGE - 0.001033*(AGE^2) + 0.1954 MARRIED) * (136.2/124).

AGE	Civ. Earnings Single Naval Aviators	Civ. Earnings Married Naval Aviators
39	$29,768	$36,193
40	$30,713	$37,340
41	$31,619	$38,442
42	$32,484	$39,494
43	$33,304	$40,491
44	$34,075	$41,428
45	$34,791	$42,299
46	$35,449	$43,099
47	$36,045	$43,824
48	$36,575	$44,468
49	$37,037	$45,030
50	$37,427	$45,504
51	$37,743	$45,888
52	$37,983	$46,180
53	$38,146	$46,378
54	$38,231	$46,481
55	$38,236	$46,487
56	$38,163	$46,398
57	$38,011	$46,213

Table C.2 (Continued)

AGE	Civ. Earnings Single Naval Aviators	Civ. Earnings Married Naval Aviators
58	$37,781	$45,935
59	$37,476	$45,563
60	$37,096	$45,101
61	$36,645	$44,552
62	$36,124	$43,919
63	$35,537	$43,205
64	$34,887	$42,416
65	$34,179	$41,554

Source: Public Use Microdata Sample (PUMS) 1990.

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